MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (STATISTICS AND PROGRAMMING)

BACHELOR OF SCIENCE (MATHEMATICS)

SMA 461: OPERATION RESEACH II

DATE: 28/7/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer question ONE (Compulsory) and any other TWO questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Distinguish the following terms in reference to traffic flow theorem

i. Microscopic and Macroscopic traffic flow models

ii. Space head way and time head way (6 marks)

b) Distinguish between the König's- Egeurary theory and the König's Hall Theory (4 marks)

c) Sate the Birkoff- Newman theorem and hence write the doubly stochastic matrix H as a convex combination of permutation matrices

$$H = \begin{pmatrix} 0 & 0.5 & 0.5 \\ 0.8 & 0.2 & 0 \\ 0.2 & 0.3 & 0.5 \end{pmatrix}$$

(6 marks)

d) A company has an annual demand of 16000 units of item L each costing sh. 200. The cost per order is sh. 1000 while the cost of capital is 24%. To purchase 10,000 or more units the price is sh.190. Justify why the management should buy with or without the discount. (6 marks)

e) A lorry can carry 4 tones, there are 3 types of objects that can be loaded. Their values and weights (tones) are given below.

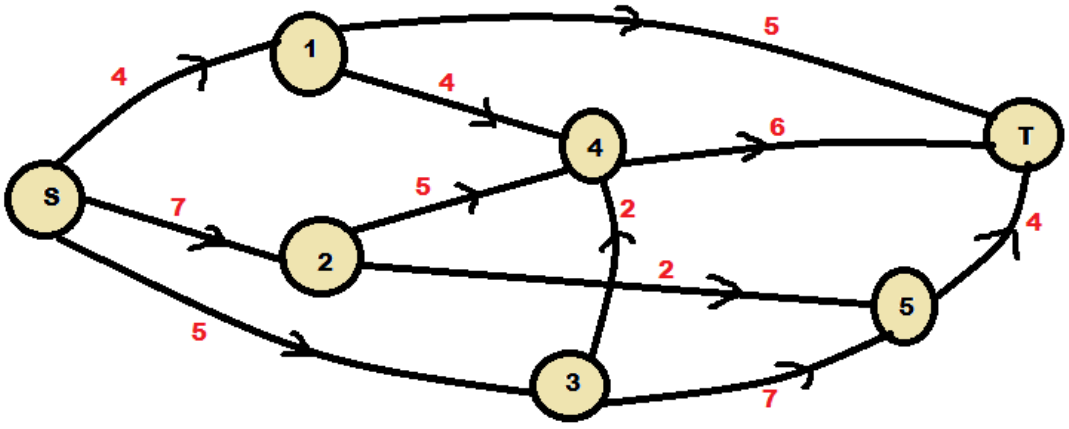
Item (i)	V_i	W_j
1	31	2
2	47	3
3	14	1

Determine the load which maximizes the value of the objects in the lorry (6 marks)

f) Highlight two negative impacts of traffic jam (2 marks)

QUESTION TWO (20 MARKS)

a) Determine the maximum flow and the minimum cut in the following network (10 marks)



b) Using the project activities details recorded below

i. Draw the network to represent the project and mark the critical path

ii. Compute the total float for the non critical activities

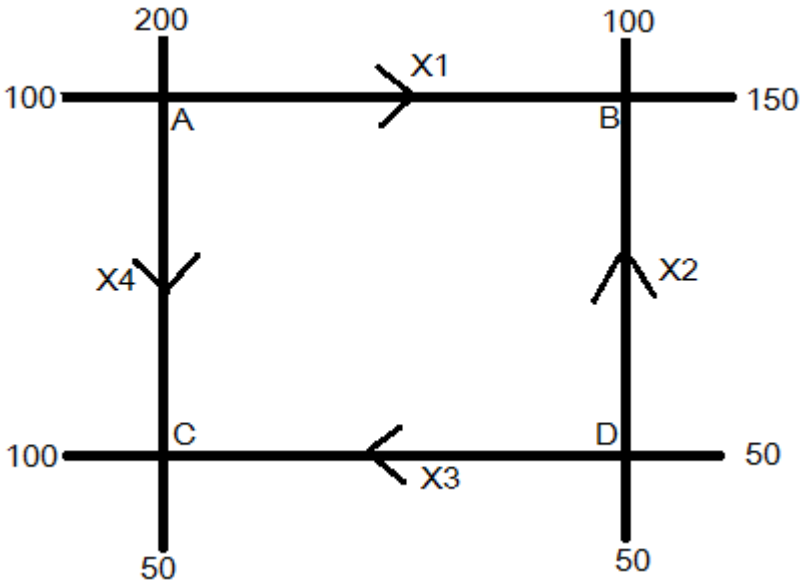
iii. Determine the probability that the project is completed within 26 weeks

(10 marks)

Activity	Preceding activity	Duration (weeks)	Standard deviation
A	----	5	1.5
B	----	6	2.0
C	A	7	2.5
D	A	4	1.0
E	A,B	2	0.5
F	C,D,E	4	1.5
G	D,E	10	3.0
H	F,G	3	1.5

QUESTION THREE (20 MARKS)

a) The figure below represents four road junctions A, B, C and D



Using the figure above

i. Construct the mathematical model to represent the traffic flow

ii. Determine the minimum flow a long AB and the flows a long DB, DC and AC at that moment. (10 marks)

b) Given the spot speeds are 50, 80, 60, 55 and 45, determine the time mean speed and space mean speed (6 marks)

c) Distinguish between the critical path method (CPM) and project evaluation and review technique (PERT) (4 marks)

QUESTION FOUR (20 MARKS)

a) The following details relate to item K10 an input in a production process. Normal consumption is 100,000kg per week, maximum consumption is 150,000kg per week, minimum consumption is 50,000kg per week, re-order quantity is 600,000kg and re-order period is 4-6 weeks. Determine;

i. Re-order level

ii. Average stock level (4 marks)

A company has 5 workers and 5 jobs. From the past experience workers can perform specific jobs as summarized below

Worker	Job performs
1	2
2	1,4
3	1,2
4	1,2,3,4
5	3,5

i. Represent the above information in a graph and a matrix
ii. Determine the maximal match (8 marks)

A firm has five positions and five applicants, given the utility matrix A, determine the optimal assignment

$$A = \begin{pmatrix} 7 & 2 & 8 & 4 & 3 \\ 5 & 4 & 6 & 3 & 3 \\ 6 & 3 & 7 & 4 & 5 \\ 5 & 2 & 5 & 2 & 4 \\ 3 & 0 & 4 & 3 & 1 \end{pmatrix}$$

(8 marks)

QUESTION FIVE (20 MARKS)

a) Highlight four conditions that may necessitate the use of simulation in modeling a system behavior (4 marks)

b) The Kulima limited company has designed a new pesticide whose production requires mainly two ingredients X1 and X_2. With the production function $y = \sqrt{x_1}x_2$ where x_1 and x_2 are the units of ingredient 1 and 2 respectively required to produce one sachet of y. The price of each sachet and the cost of the ingredients are random variables such that

SP (y)	Probability
4000	0.15
4500	0.35
5000	0.20
5500	0.30

Cost (x1)	Probability
1000	0.1
1500	0.05
2000	0.35
2500	0.50

Cost (x2)	Probability
1500	0.20
2000	0.25
2500	0.15
3000	0.40

i. Given that the daily usage of x1 and x2 are set at 250 and 360 units respectively. Determine the expected profit of the company. (6 marks)

ii. Simulate the company's profit for 10 days using the random numbers;

58,71,96,30,24,18,09,24,18,46,23,34,27,85,13,99,24,44,49,79,49,74,16,32,23,02,56,88,87,59. (10 marks)